University of Idaho

Overview of the Nervous System

Psychology 472

Pharmacology of Psychoactive Drugs

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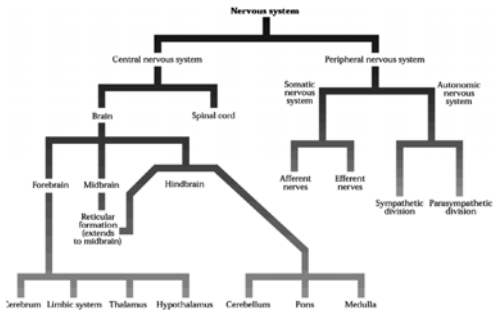
First

- **All parts are interrelated.**
- **Thus, you need all parts to function normally.**
- **Neurons = Nerve cells**

The Nervous System is Composed of Two Parts

- **Central Nervous System**
  - **Consists of all neurons (nerve cells) located in the brain and spinal cord**
- **Peripheral Nervous System**
  - **Consists of all neurons (nerve cells) located outside the brain and spinal cord.**



Peripheral Nervous System

- **Two divisions**
  - **Somatic**
  - **Autonomic**

Somatic System

- **Two parts**
- **1. Afferent neurons**
  - **Are sensory in nature.**
  - **Receive information from sensory receptors (structures) and sends that information toward the central nervous system**

Efferent neurons

- Are motor in nature
- Gets information from the central nervous system and sends it to the muscles of the body.

Autonomic System

- Consists of neurons that go to and from various internal organs.
- Regulates heart rate, blood pressure, digestion, etc.
- Has two parts
- Sympathetic nervous system
- Parasympathetic nervous system

Think of What Happens When a Lion Chases You

Sympathetic	Parasympathetic
Increases Heart Rate	Decreases Heart Rate
Increases Respiration	Decreases Respiration
Decreases Digestion	Increases Digestion

Central Nervous System

Consists of

- Brain
- Spinal Cord

Brain

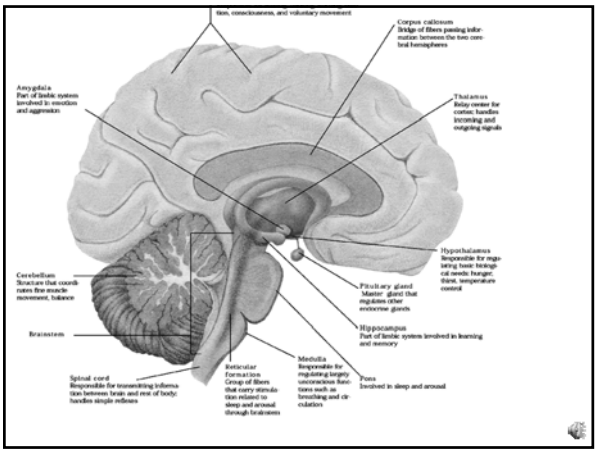
- Has 100 billion neurons or nerve cells
- Neurons are the functional element of the brain.
- Also has approximately 120 billion Glial cells

Glial

Has many functions

.Acts as a glue
.Provides nutrients
.Helps Regulate Brain Activity
.Eliminates Wastes
.Breaks down Neurotransmitters
.Makes Myelin

Best way to conceptualize the brain is how it develops through evolution



Hind Brain

- **Also called Reptilian Brain**

Consists of three structures
Medulla, Pons, Cerebellum

Medulla

Controls breathing, heart rate, digestion, blood pressure, temperature and other things

Is the structure that keeps you alive. You can damage other parts of the brain and live, if you damage the medulla, you usually will die

Pons

- **Is responsible for wakefulness or the sleep cycle**

Cerebellum

- **Is behind the medulla and pons**
- **Helps control muscle tone, body balance**
- **In general, it helps coordinate voluntary muscle movement**
- **Also smoothes out muscle movement so it is not jerky.**
- **Is extremely important for controlling <u>rapid movement</u> such as startle responses**
- **Is also important for maintaining body balance**

Midbrain

Two major sets of structures

1. Superior and Inferior Colliculi
   - superior means above
   - inferior means below
   - Thus, the superior colliculi is above the inferior colliculi
2. Reticular formation

Superior Colliculi

- Superior means above
- Function
  - Receives fibers from the retina of the eye and sends information to the cerebral cortex.
  - Is important for controlling eye movements (especially tracking).

Inferior Colliculi

- Receives information from the cochlea of the ear and sends to the cortex.
- Has a role in organizing auditory stimuli.

Reticular Formation

- Is another part of the midbrain
- Are sets of fibers that go from the lower brain Stem (all structures in the hind and mid brain) and extends to the Thalamus.
- Thus, has fibers in both the hind and mid brain

Functions

Is important for controlling your state of arousal

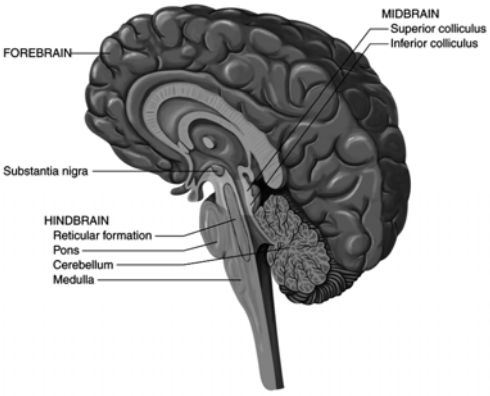
May play a role in sleep.

Has an important role in focusing attention and acting as a filter.

Allows you to concentrate on important things while ignoring unimportant things (buzz of a light)

BRAIN STEM

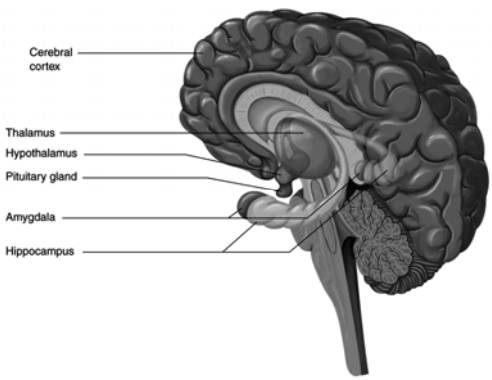
- People talk about the brain stem.
- Consists of all structures in both the Hind and Mid Brain



Forebrain

- Consists of several structures in two major areas
  - Diencephalon (inter brain)
  - Telencephalon (end brain)

Encephalon = Brain



Diencephalon

- Consists of many structures
  - Thalamus
  - Hypothalamus
  - Others (you do not have to know about)

Thalamus

Is basically a relay station from sensory structures to the cortex and back.

Is a major center for collecting and integrating information

e.g., 80% of all fibers from the optic nerve of the eye goes to the thalamus before going to the occipital lobe (other 20% go to the superior colliculi).

Also has a role in memory formation

Hypothalamus

- Is in charge of several things
- Is smaller than the thalamus and is located in front of and below the thalamus (hypo = below).
- Weighs only about 4 grams Brain=1400 grams

Regulates

- **Control of blood pressure and electrolyte composition.**
- **Body temperature**
- **Energy metabolism**
- **Reproduction**
- **Emergency responses to stress**

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Hypothalamic Regions and Related Structures

- **Can be divided into three regions**
  - **Anterior**
  - **Middle**
  - **Posterior**

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Anterior

- **Contains the Preoptic Nucleus**
  - **Is concerned with the integration of sensory stimuli that is related to set points.**

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Middle Third

- Overlays the pituitary stalk
- Contains
  - Dorsomedial Nuclei
  - Ventromedial Nuclei
  - Paraventricular Nuclei
  - Supraoptic Nuclei
  - Arcuate Nuclei

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Paraventricular Nuclei

- Contains neurons that innervate sympathetic and parasympathetic neurons in the Medulla and Spinal Cord.
  - Regulates autonomic responses

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Ventromedial and Dorsomedial Nuclei

- Regulates
  - Growth
  - Feeding
  - Maturation
  - Reproduction

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Medial Forebrain Bundle

- MFB are long pathways
- Runs through the lateral hypothalamus
- Connects the hypothalamus with the
  - Brain Stem
  - Basal Forebrain
  - Amygdala
  - Cortex

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Function

- Help organize behaviors
- Autonomic functioning
- Highly involved with the addiction process
- Heavily loaded with Dopamine Neurons

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Endocrine System

- Regulated by the Hypothalamus
- Direct Connection
  - Sends neuroendocrine materials from the posterior pituitary
- Indirect
  - Sends hormones into the anterior pituitary
  - Regulates the production and release of pituitary hormones into circulatory system

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Telencephalon

- **These structures have increased the most as evolution has progressed.**
- **Has several major groups of structures.**

Olfactory System

- **Is involved with smell**

Limbic System

- **Has several structures**
- **Septal area**
- **Amygdala**
- **Hippocampus**
- **Parahippocampus**

Septal Area

- Is involved with controlling aggression and pleasure

Amygdala

- Is involved with controlling rage behavior and aggression
- When destroyed, the organism attacks anything

Hippocampus and Parahippocampus

- Has a major role in memory formation
- When damaged, you cannot form any new memories

Hypothalamus

- Is involved with emotional behavior
- May be involved with pleasure, pain, and anger
- Is also categorized in two groups. Diencephalon and Telencephalon

In general, the limbic system controls animal instinctive behavior

Basal Ganglia

- Has several structures as well.
  - Caudate Nucleus
  - Lenticular Formation
  - Putamen
  - Red Nucleus
  - Substantia Nigra

Like the Cerebellum

- Is involved with controlling movement.
- While cerebellum controls rapid movement;
- Basal Ganglia helps with
  - Controlling slower movements
  - Starting and stopping movement
  - Balance

In General

- The basal ganglia controls the direction and amplitude of movement; especially postural movement.

When Damaged

Causes problems with posture, walking, etc.
Get a lot of tremors, jerks, twitching, etc.

Parkinson's syndrome

- Classic symptom tremor at rest.
- Once you move the tremor stops until in later stages of the disease, then you always have tremors.

Occurs because the Substantia Nigra degenerates.

Causes

- In the past, it was thought to be genetic or viral
- Today, we know that it can be environmentally caused

Example 1

- Barry Kidson Chem Grad Student
- Trying to create synthetic opiate to get high
- Contaminated with MPTP
- MPTP is converted to MPP+ by the body
- MPP+ is selectively toxic to the Substantia Nigra
- Causes rigidity - like a stone
- Major source of MPTP in the environment is Parquet
- Parquet is a herbicide

Example 2

- Punch Drunk Syndrome
  Boxers are hit on the head
- Ultimately, the brain swells and basal ganglia degenerates.
  Result - Same problem as Parkinsons
  Tremor at rest, talking problems etc.
- Ali
- Can occur with other sports as well where head contact occurs.
  - Soccer

Conclusions

- **Lots of structures in Hind and Mid Brain**
- **Very important in normal body functioning**
- **Are affected later than cortical structures by alcohol**
  - **Keeps you alive**